

What is claimed:

Fig 1

1. An energy-absorbing floor-assembly of a motor vehicle, having a vehicle floor, vehicle body, front and rear bumper and a vehicle frame, defined by a pair of longitudinal runners (30), a pair of side rails (34) and at least one cross member (31 to 33), which is in connection with the vehicle floor, the pair of longitudinal runners and the pair of side rails, comprising at least one deformable element (1, 2, 3), arranged to the vehicle floor between the pair of front pillars and the rear bumper (36) in order to ensure the absorption of large energy when the deformable element is deformed in an accident.

Fig 1

2. An energy-absorbing floor-assembly according to claim 1, further comprising at least one pair of independently operating piston devices, each of which, longitudinally arranged in the front section of the vehicle body, consists of an impact pan (5.1), located in the vicinity of the front bumper, at least one piston rod (5, 5a to 5d) and a piston (1.2), located in front of the front-end portion (1.1) of the deformable element; and

the bearing boxes (30.7, 30.7a to 30.7c), arranged to the pair of longitudinal runners to guide the respective piston rods (5, 5a, 5c);

thus ensuring the energy absorption when both pistons, loaded by the impact energy in the event of arbitrary front collision, independently operate to deform the deformable element.

Fig 1 to 6,

3. An energy-absorbing floor-assembly according to claim 2, further comprising a pair of side deformable elements (2, 2a, 2b, 2c, 2d, 2e, 2a1, 2a2, 2a3), each of which is projected through the side rail, has one side portion arranged along the side portion of the main deformable element while the other side portion abutting along the vehicle side in order to ensure the energy absorption when the vehicle side is deformed by the impact energy in the event of arbitrary side collision.

15 to 18

4. An energy-absorbing floor-assembly according to claim 3, further comprising

Fig 1, 19 to 22

a detachable deformable element (3, 3a), serving as an upper floor of the trunk compartment, which is in form-locking connection with the pair of portions (30.1, 30.3) of the longitudinal runners and both wheel cases (40), abutting along the cross member (30, 33), connected to the pair of longitudinal runners and the pair of side rails, and along a rear wall of the bumper (35, 36) as well as being releasable therefrom; and

a deformable floor (3c), serving as a lower floor of the trunk compartment and attached to the longitudinal runners and both wheel cases (40) to form storage rooms, which are covered by the detachable deformable element;

thus ensuring the energy absorption in the event of arbitrary front, side or rear collision.

5. An energy-absorbing floor-assembly according to claim 4, wherein the detachable deformable element (3) comprises

Figs 1, 19, 20

a central deformable member (3.1), the engaging pins (3.5) of which are longitudinally arranged parallel to the mating holes of both rear portions (30.3) of the longitudinal runners and are in form-locking connection thereto; and

a pair of deformable members (3.2), pivotally connected to the central deformable member (3.1) by the hinges (3.3), which are swung down to cover the storage rooms and to rest on the supporting collars (40.2) of both wheel cases (40), thus resulting in form-locking connection

- of the lateral surfaces to the C-shaped rear wheel cases; and

- of the engaging holes on the lateral surfaces to the mating pins (40.1), rigidly attached to

the wheel cases;

where the deformable element is subdivided into a number of crumpling zones to control the rate of deceleration in a rear collision.

6. An energy-absorbing floor-assembly according to claim 4, wherein the detachable deformable element (3a) comprises

a central deformable member (3.1a), having engaging first pins (3.5a), longitudinally arranged parallel to the common mating holes of both rear portions (30.3) of the longitudinal runners,

Pgs 21, 22

and a transverse guide beam (3.8), the engaging second pins (3.7) of which are arranged parallel to the mating holes of an engaging rail (3.9) of the transverse portion (33.2) of the rear cross member, where all the engaging pins are in form-locking connection with the mating holes; and

5 a pair of deformable members (3.2a) which are lowered to cover the storage rooms and to rest on the supporting collars (40.2) of both wheel cases (40), thus resulting in form-locking connection

- of the lateral surfaces to the C-shaped rear wheel cases;
- of the engaging holes on the lateral surfaces to the mating pins (40.1), rigidly attached to
- 10 the wheel cases; and
- of the engaging third pins (3.6a) to the mating recesses of the central deformable member and to the common mating holes of both rear portions (30.3) of the longitudinal runners;

where the deformable element is subdivided into a number of crumpling zones to control the rate of deceleration in a side or rear collision.

15 7. An energy-absorbing floor-assembly according to claim 4, wherein the detachable deformable element (3) comprises

≡ Claim 5

a central deformable member (3.1), the engaging pins (3.5) of which are longitudinally arranged parallel to the mating holes of both front portions (30.1) of the longitudinal runners and are in form-locking connection thereto; and

20 a pair of deformable members (3.2), pivotally connected to the central deformable member (3.1) by the hinges (3.3), which are swung down to cover the storage rooms and to rest on the supporting collars (40.2) of both wheel cases (40), thus resulting in form-locking connection

- of the lateral surfaces to the C-shaped front wheel cases; and
- of the engaging holes on the lateral surfaces to the mating pins (40.1), rigidly attached to

25 the wheel cases;

where the deformable element is subdivided into a number of crumpling zones to control the rate of deceleration in a front collision.

8. An energy-absorbing floor-assembly according to claim 4, wherein the detachable deformable element (3a) comprises

≡ claim 6

a central deformable member (3.1a) having engaging first pins (3.5a), longitudinally arranged parallel to the common mating holes of both front portions (30.1) of the longitudinal runners, and a transverse guide beam (3.8), the engaging second pins (3.7) of which are arranged parallel to the mating holes of an engaging rail (3.9) of the transverse portion (33.2) of the front cross member, where all the engaging pins are in form-locking connection with the mating holes; and

a pair of deformable members (3.2a) which are lowered to cover the storage rooms and to rest on the supporting collars (40.2) of both wheel cases (40), thus resulting in form-locking connection

- of the lateral surfaces to the C-shaped front wheel cases;
- of the engaging holes on the lateral surfaces to the mating pins (40.1), rigidly attached to the wheel cases; and
- of the engaging third pins (3.6a) to the mating recesses of the central deformable member and to the common mating holes of both front portions (30.1) of the longitudinal runners;

where the deformable element is subdivided into a number of crumpling zones to control the rate of deceleration in a side or front collision.

9. An energy-absorbing floor-assembly according to claim 3, wherein the side deformable element (2), guided by the U-shaped front and rear cross members (31.1, 33.1), is provided with a number of bolts (2.1), provided with sites of predetermined fracture, to engage with the mating holes of the pieces (2.4) of the side rail (34), provided with sound-proofing pieces (2.3), where the height of the side deformable element is adjusted by a tool inserted through the overlapping holes of the side rail into a hexagon socket head of the bolt.

Figs 4, 8

10. An energy-absorbing floor-assembly according to claim 9, wherein the ledge of the side deformable element (2a1, 2a2, 2a3) serves as a side bumper.

Fig 6

Fig 6

11. An energy-absorbing floor-assembly according to claim 10, wherein the ledge of the side deformable element serves as a step rail (2.8).

Fig. 10

12. An energy-absorbing floor-assembly according to claim 4, wherein controllable deformation behaviour of the deformable element is determined by crumpling zones ($Z_1, Z_2, Z_3, Z_4, \dots Z_{n+1}$), resulting from a subdivision thereof and provided with sites of predetermined fracture, and by inequal stiffness of the juxtaposed crumpling zones, which yield different stress when loaded.

Figs 1, 12 to 22,

13. An energy-absorbing floor-assembly according to claim 12, wherein the deformable element is in form-locking connection with at least one frame member, generally representing the cross member, longitudinal runner, tunnel rail or side rail.

31 to 33

14. An energy-absorbing floor-assembly according to claim 12, wherein the deformable element is in force-locking connection with at least one frame member.

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15. An energy-absorbing floor-assembly according to claim 12, wherein the deformable element is in form- and force-locking connection with at least one frame member.

16. An energy-absorbing floor-assembly according to claim 12, wherein the deformable elements are in form-locking connection with each other.

17. An energy-absorbing floor-assembly according to claim 12, wherein the deformable elements are in force-locking connection with each other.

18. An energy-absorbing floor-assembly according to claim 12, wherein the deformable elements are in form- and force-locking connection with each other.

Figs 12 to 14, 23

19. An energy-absorbing floor-assembly according to claim 12, wherein the deformable element is provided by at least one guide tube (1.8, 1.8a, 1.8b) to receive an auxiliary tube (60b, 60c, 60c1, 60c2).

Figs 25, 30, 5

20. An energy-absorbing floor-assembly according to claim 2, wherein a spring, serving as an intermediate deformable element, interposed between the piston (1.2) and the front of the front-end portion (1.1) of the deformable element, is provided with sites of predetermined fracture.

Fig. 11

21. An energy-absorbing floor-assembly according to claim 12, wherein the crumpling zones are defined by stiffness, varying in longitudinal direction.

Figs 10, 22

22. An energy-absorbing floor-assembly according to claim 12, wherein the crumpling zones are defined by inequal distances to each other.

Figs 10, 12, 13

5 23. An energy-absorbing floor-assembly according to claim 12, wherein the crumpling zones are defined by transition sites, serving as sites of predetermined fracture.

Figs 1, 10

24. An energy-absorbing floor-assembly according to claim 12, wherein the crumpling zones are defined by honeycomb-shapes, having different stiffness.

Fig. 15 to 18

10 25. An energy-absorbing floor-assembly according to claim 12, wherein the engaging parts and mating receptacles of interengaging assemblies define the crumpling zones of the first and second deformable element, where the mating receptacles are inserted into the respective engaging parts to connect both elements and to increase the energy-absorbing masses in any collision.

26. An energy-absorbing floor-assembly according to claim 25, wherein the interengaging assemblies comprise

Fig 15

15 upper and lower engaging pins (1.15), distributed on the respective upper and lower transition areas of juxtaposed crumpling zones of the first deformable element (1e) in x-direction; and the mating L-shaped oblong holes, distributed along both legs of the U-shaped portion of the second deformable element (2b), serving as upper and lower transition sites of juxtaposed crumpling zones thereof;

20 where the corresponding crumpling zones of both deformable elements are interconnected when the mating L-shaped oblong holes are inserted into the upper and lower engaging pins in the y-direction, which are secured in the U-forms of the mating L-shaped oblong holes by the movement of the second deformable element in the x-direction.

25 27. An energy-absorbing floor-assembly according to claim 25, wherein the interengaging assemblies comprise

Fig 16

upper and lower engaging pins (1.15), distributed on the respective upper and lower transition areas of juxtaposed crumpling zones of the first deformable element (1e) in x-direction; and the mating T-shaped oblong holes, distributed along both legs of the U-shaped portion of the second deformable element (2c), serving as upper and lower transition sites of juxtaposed crumpling zones thereto;

where the corresponding crumpling zones of both deformable elements are interconnected when the mating T-shaped oblong holes are inserted into the upper and lower engaging pins in the y-direction, which are secured in the U-forms of the mating T-shaped oblong holes by the movement of the second deformable element in the x-direction.

28. An energy-absorbing floor-assembly according to claim 25, wherein the interengaging assemblies comprise

Fig 17

engaging pins (1.15), distributed on the upper transition areas of juxtaposed crumpling zones of the first deformable element (1e) in x-direction; and the mating T-shaped oblong holes, distributed along the upper leg of the U-shaped portion of the second deformable element (2d), serving as transition sites of juxtaposed crumpling zones thereof;

where the corresponding crumpling zones of both deformable elements are interconnected, when the mating T-shaped oblong holes are inserted into the engaging pins in the y-direction, which are secured in the U-forms of the mating T-shaped oblong holes by the movement of the second deformable element in the x-direction, and when the sites of the lower transition areas of juxtaposed crumpling zones of the second deformable element are rigidly connected to the mating sites of the first deformable element.

29. An energy-absorbing floor-assembly according to claim 25, wherein the interengaging assemblies comprise

Fig 18

engaging pins (2.1b), both ends of which are attached to both legs of the U-shaped portion of the second deformable element (2e), serving as transition sites of juxtaposed crumpling zones of the second deformable element (2e); and

the mating recesses of the first deformable element (1f) on the transition areas between the juxtaposed crumpling zones, which are provided with guide tubes (1.8b) in the common axis; where the corresponding crumpling zones of both deformable elements are interconnected, when the engaging pins are inserted into the mating recesses and secured therein by an auxiliary tube (60c), projected through the guide tubes of all the crumpling zones in the common axis.

30. An energy-absorbing floor-assembly of a motor vehicle, having a vehicle floor, vehicle body, front (35) and rear bumper (36) and a vehicle frame, defined by a pair of open cross sectional longitudinal runners (30a), a pair of open cross sectional side rails (34a), an open cross sectional tunnel rail (60d), a front (31a), rear cross member (33a) and an open cross sectional intermediate cross member (32c), where all cross members are in connection with the vehicle floor, the pair of longitudinal runners, the pair of side rails and the tunnel rail and bores in the common axes are arranged in the front and rear cross member, comprising

a single deformable element (1), inserted between the front and rear cross member, through the side rails, the longitudinal runners, the tunnel rail and the intermediate cross member, being in abutting relationship to both vehicle sides and fastened at the rear-end portion to the rear cross member;

a pair of independently operating piston devices, each of which, longitudinally arranged in the front section of the vehicle body, consists of an impact pan (5.1), located in the vicinity of the front bumper, a piston rod (5) and a front piston (1.2), located at a distance of (10) to the front-end portion of the deformable element;

two pairs of auxiliary tubes (60c), projected through the deformable element and the bores of the front and rear cross member in the common axes, fastened to the front and rear cross member, securing and guiding the deformable element to prevent lateral buckling, when the deformable element absorbs the impact energy in any front collision;

a pair of bearing boxes (30.7), arranged in the front portions of the longitudinal runners, to guide the respective piston rods (5);

a pair of springs (4d), loosely guided by the piston rods, where the springs, biasing the front bumper via the impact pans, store minor energy up to the deflection of (10), when the vehicle collides against a barrier when parking, and release the energy, when the vehicle is reversed, thus pushing the bumper back to the home position and making repair unnecessary; and
5 a rear deformable element (3c), fastened to the attachment sites of predetermined fracture of both rear portions of the longitudinal runners;

thus ensuring the energy absorption in any front, side or rear collision or in a pile up.

Fig 32

31. An energy-absorbing floor-assembly of a motor vehicle, having a vehicle floor, vehicle body, front (35) and rear bumper (36) and a vehicle frame, defined by a pair of open cross sectional
10 longitudinal runners (30a), a pair of open cross sectional side rails (34a), a pair of U-shaped tunnel rails (60e), a front (31b), rear cross member (33b) and an intermediate cross member (32b), where all cross members are in connection with the vehicle floor, the tunnel rail, the pair of longitudinal runners and the pair of side rails and bores in the common axes are arranged in the front and rear cross member, comprising

15 a pair of front deformable elements (1), each of which is inserted between the front and intermediate cross member, through the side rail, the longitudinal runner into the U-shaped tunnel rail and fastened at the rear-end portion to an auxiliary plate (32.6) of the intermediate cross member;

a pair of independently operating twin piston devices, each of which, longitudinally arranged in
20 the front section of the vehicle body, consists of two piston rods (5, 5a), connected to the front bumper with sites of predetermined fracture, and a common front piston (1.2), fastened to the front-end portion of the front deformable element to prevent lateral buckling;

a pair of auxiliary front tubes (60c1), each of which is projected through each front deformable element, common front piston and the bore of the front and intermediate cross member in the
25 common axis, fastened to the front and intermediate cross member and guides the front deformable element to prevent lateral buckling, when the front deformable element absorbs the impact energy in any front collision;

a pair of front double bearing boxes (30.7), the engaging receptacles of which are plug-in and force-locking connected to the mating parts of the respective front-end portions of the longitudinal runners, to guide the respective piston rods (5, 5a);

a pair of rear deformable elements (1), each of which is inserted between the intermediate and rear cross member, through the side rail, the longitudinal runner into the U-shaped tunnel rail and fastened at the front-end portion to an auxiliary plate (32.6) of intermediate cross member;

a pair of independently operating piston devices, each of which, longitudinally arranged in the rear section of the vehicle body, consists of a piston rod (5b), connected to the rear bumper with sites of predetermined fracture, and a rear piston (1.2), fastened to the rear-end portion of the rear deformable element to prevent lateral buckling;

a pair of auxiliary rear tubes (60c2), each of which is projected through each rear deformable element, the rear piston and the bore of the rear and intermediate cross member in the common axis, fastened to the rear and intermediate cross member and guides the rear deformable element to prevent lateral buckling, when the rear deformable element absorbs the impact energy in any rear collision; and

a pair of side deformable elements (2a3), each of which is inserted through the side rail, between the front and intermediate cross member, between the intermediate and rear cross member, connected to the front and rear deformable element and fastened to the attachment sites of predetermined fracture of the respective auxiliary plates (31.5, 32.5, 33.5) of all cross members;

thus ensuring the energy absorption in any front, side or rear collision or in a pile up.

Fig 32. An energy-absorbing floor-assembly according to claim 31, wherein any part of a power train is housed in the tunnel space, defined by the pair of U-shaped tunnel rails and the vehicle floor.

Fig 33. An energy-absorbing floor-assembly of a motor vehicle, having a vehicle floor, vehicle body, front (35) and rear bumper (36) and a vehicle frame, defined by a pair of open cross sectional

longitudinal runners (30a), a pair of open cross sectional side rails (34), a open cross sectional tunnel rail (60d), a front (31a), rear cross member (33a) and an intermediate cross member (32c), where bores in the common axes are arranged in all cross members in connection with the vehicle floor, the tunnel rail, the pair of longitudinal runners and the pair of side rails, comprising

- 5 a single deformable element (1), inserted between the front and rear cross member, through the side rails, the longitudinal runners, the tunnel rail and the intermediate cross member, being in abutting relationship to both vehicle sides and fastened to the intermediate cross member;
- a pair of independently operating twin piston devices, each of which, longitudinally arranged in the front section of the vehicle body, consists of two piston rods (5, 5c), connected to the
- 10 front bumper with sites of predetermined fracture, and a common front piston (1.2), fastened to the front-end portion of the deformable element to prevent lateral buckling;
- a pair of front bearing boxes (30.7), the engaging receptacles of which are plug-in and force-locking connected to the mating parts of the respective front portions of the longitudinal runners, to guide the respective piston rods (5, 5c);
- 15 a pair of independently operating twin piston devices, each of which, longitudinally arranged in the rear section of the vehicle body, consists of two piston rods (5b, 5d), connected to the rear bumper with sites of predetermined fracture, and a common rear piston (1.2), located at a distance of (10) to the rear portion of the deformable element;
- a pair of rear bearing boxes (30.7), the engaging receptacles of which are plug-in and force-
- 20 locking connected to the mating parts of the respective rear portions of the longitudinal runners, to guide the respective piston rods (5b 5d);
- a pair of springs (4c), arranged between the rear-end portion of the deformable element and the respective piston rods (5b), where the springs, biasing the rear bumper, store minor energy up to the deflection of (10), when the vehicle collides against a barrier when parking, and release
- 25 the energy, when the vehicle is reversed, thus pushing the bumper back to the home position and making repair unnecessary; and

a pair of auxiliary tubes (60b), which are projected through the deformable element, both common front pistons, both common rear pistons and the bores of the front and rear cross member in the common axes, fastened to the front, intermediate and rear cross member and which guide the deformable element to prevent lateral buckling, when the deformable element
5 absorbs the impact energy in any collision;

thus ensuring the energy absorption in any front, side or rear collision or in a pile up.

34. An energy-absorbing floor-assembly according to claim 33, wherein the bearing box is an extrusion component.

Figs 26 to 28

35. An energy-absorbing floor-assembly according to claim 34, wherein the bearing box has a
10 number of bores to guide the piston rods.

Fig 28

36. An energy-absorbing floor-assembly according to claim 34, wherein the bearing box has a number of bores to guide at least one piston rod and to receive at least one auxiliary tube.

Fig 28

37. An energy-absorbing floor-assembly according to claim 33, wherein the bumper is substituted by at least one pair of impact pans.

Fig 1

15 38. An energy-absorbing floor-assembly, characterised by use of metal, compound material, glass fibre reinforced material or non-metal material for material of parts of the interengaging assembly, of the piston device, of the deformable element and of the deformable member.

What is claimed:

1. An energy-absorbing floor-assembly of a motor vehicle, having a vehicle floor, vehicle body, front and rear bumper and a vehicle frame, defined by a pair of longitudinal runners (30), a pair of side rails (34) and at least one cross member (31 to 33), which is in connection with the vehicle floor, the pair of longitudinal runners and the pair of side rails, comprising at least one deformable element (1, 2, 3), arranged to the vehicle floor between the pair of front pillars and the rear bumper (36) in order to ensure the absorption of large energy when the deformable element is deformed in an accident.
2. An energy-absorbing floor-assembly according to claim 1, further comprising at least one pair of independently operating piston devices, each of which, longitudinally arranged in the front section of the vehicle body, consists of an impact pan (5.1), located in the vicinity of the front bumper, at least one piston rod (5, 5a to 5d) and a piston (1.2), located in front of the front-end portion (1.1) of the deformable element; and the bearing boxes (30.7, 30.7a to 30.7c), arranged to the pair of longitudinal runners to guide the respective piston rods (5, 5a, 5c);
thus ensuring the energy absorption when both pistons, loaded by the impact energy in the event of arbitrary front collision, independently operate to deform the deformable element.
3. An energy-absorbing floor-assembly according to claim 2, further comprising a pair of side deformable elements (2, 2a, 2b, 2c, 2d, 2e, 2a1, 2a2, 2a3), each of which is projected through the side rail, has one side portion arranged along the side portion of the main deformable element while the other side portion abutting along the vehicle side in order to ensure the energy absorption when the vehicle side is deformed by the impact energy in the event of arbitrary side collision.
4. An energy-absorbing floor-assembly according to claim 3, further comprising a detachable deformable element (3, 3a), serving as an upper floor of the trunk compartment, which is in form-locking connection with the pair of portions (30.1, 30.3) of the longitudinal runners and both wheel cases (40), abutting along the cross member (30, 33), connected to the pair of longitudinal runners and the pair of side rails, and along a rear wall of the bumper (35, 36) as well as being releasable therefrom; and a deformable floor (3c), serving as a lower floor of the trunk compartment and attached to the longitudinal runners and both wheel cases (40) to form storage rooms, which are covered by the detachable deformable element;
thus ensuring the energy absorption in the event of arbitrary front, side or rear collision.
5. An energy-absorbing floor-assembly according to claim 4, wherein the detachable deformable element (3) comprises
a central deformable member (3.1), the engaging pins (3.5) of which are longitudinally arranged parallel to the mating holes of both rear portions (30.3) of the longitudinal runners and are in form-locking connection thereto; and
a pair of deformable members (3.2), pivotally connected to the central deformable member (3.1) by the hinges (3.3), which are swung down to cover the storage rooms and to rest on the supporting collars (40.2) of both wheel cases (40), thus resulting in form-locking connection
– of the lateral surfaces to the C-shaped rear wheel cases; and
– of the engaging holes on the lateral surfaces to the mating pins (40.1), rigidly attached to the wheel cases;

where the deformable element is subdivided into a number of crumpling zones to control the rate of deceleration in a rear collision.

6. An energy-absorbing floor-assembly according to claim 4, wherein the detachable deformable element (3a) comprises

- 5 a central deformable member (3.1a), having engaging first pins (3.5a), longitudinally arranged parallel to the common mating holes of both rear portions (30.3) of the longitudinal runners, and a transverse guide beam (3.8), the engaging second pins (3.7) of which are arranged parallel to the mating holes of an engaging rail (3.9) of the transverse portion (33.2) of the rear cross member, where all the engaging pins are in
- 10 form-locking connection with the mating holes; and
- a pair of deformable members (3.2a) which are lowered to cover the storage rooms and to rest on the supporting collars (40.2) of both wheel cases (40), thus resulting in form-locking connection
 - of the lateral surfaces to the C-shaped rear wheel cases;
 - 15 – of the engaging holes on the lateral surfaces to the mating pins (40.1), rigidly attached to the wheel cases; and
 - of the engaging third pins (3.6a) to the mating recesses of the central deformable member and to the common mating holes of both rear portions (30.3) of the longitudinal runners;

20 where the deformable element is subdivided into a number of crumpling zones to control the rate of deceleration in a side or rear collision.

7. An energy-absorbing floor-assembly according to claim 4, wherein the detachable deformable element (3) comprises

- 25 a central deformable member (3.1), the engaging pins (3.5) of which are longitudinally arranged parallel to the mating holes of both front portions (30.1) of the longitudinal runners and are in form-locking connection thereto; and
- a pair of deformable members (3.2), pivotally connected to the central deformable member (3.1) by the hinges (3.3), which are swung down to cover the storage rooms and to rest on the supporting collars (40.2) of both wheel cases (40), thus resulting in form-locking
- 30 connection
 - of the lateral surfaces to the C-shaped front wheel cases; and
 - of the engaging holes on the lateral surfaces to the mating pins (40.1), rigidly attached to the wheel cases;

35 where the deformable element is subdivided into a number of crumpling zones to control the rate of deceleration in a front collision.

8. An energy-absorbing floor-assembly according to claim 4, wherein the detachable deformable element (3a) comprises

- 40 a central deformable member (3.1a) having engaging first pins (3.5a), longitudinally arranged parallel to the common mating holes of both front portions (30.1) of the longitudinal runners, and a transverse guide beam (3.8), the engaging second pins (3.7) of which are arranged parallel to the mating holes of an engaging rail (3.9) of the transverse portion (33.2) of the front cross member, where all the engaging pins are in form-locking connection with the mating holes; and

a pair of deformable members (3.2a) which are lowered to cover the storage rooms and to rest on the supporting collars (40.2) of both wheel cases (40), thus resulting in form-locking connection

- of the lateral surfaces to the C-shaped front wheel cases;
- 5 - of the engaging holes on the lateral surfaces to the mating pins (40.1), rigidly attached to the wheel cases; and
- of the engaging third pins (3.6a) to the mating recesses of the central deformable member and to the common mating holes of both front portions (30.1) of the longitudinal runners;

10 where the deformable element is subdivided into a number of crumpling zones to control the rate of deceleration in a side or front collision.

9. An energy-absorbing floor-assembly according to claim 3, wherein the side deformable element (2), guided by the U-shaped front and rear cross members (31.1, 33.1), is provided with a number of bolts (2.1), provided with sites of predetermined fracture, to engage with
15 the mating holes of the pieces (2.4) of the side rail (34), provided with sound-proofing pieces (2.3), where the height of the side deformable element is adjusted by a tool inserted through the overlapping holes of the side rail into a hexagon socket head of the bolt.

10. An energy-absorbing floor-assembly according to claim 9, wherein the ledge of the side deformable element (2a1, 2a2, 2a3) serves as a side bumper.

20 11. An energy-absorbing floor-assembly according to claim 10, wherein the ledge of the side deformable element serves as a step rail (2.8).

12. An energy-absorbing floor-assembly according to claim 4, wherein controllable deformation behaviour of the deformable element is determined by crumpling zones ($Z_1, Z_2, Z_3, Z_4, \dots Z_{n+1}$), resulting from a subdivision thereof and provided with sites of predetermined
25 fracture, and by unequal stiffness of the juxtaposed crumpling zones, which yield different stress when loaded.

13. An energy-absorbing floor-assembly according to claim 12, wherein the deformable element is in form-locking connection with at least one frame member, generally representing the cross member, longitudinal runner, tunnel rail or side rail.

30 14. An energy-absorbing floor-assembly according to claim 12, wherein the deformable element is in force-locking connection with at least one frame member.

15. An energy-absorbing floor-assembly according to claim 12, wherein the deformable element is in form- and force-locking connection with at least one frame member.

35 16. An energy-absorbing floor-assembly according to claim 12, wherein the deformable elements are in form-locking connection with each other.

17. An energy-absorbing floor-assembly according to claim 12, wherein the deformable elements are in force-locking connection with each other.

18. An energy-absorbing floor-assembly according to claim 12, wherein the deformable elements are in form- and force-locking connection with each other.

19. An energy-absorbing floor-assembly according to claim 12, wherein the deformable element is provided by at least one guide tube (1.8, 1.8a, 1.8b) to receive an auxiliary tube (60b, 60c, 60c1, 60c2).

5 20. An energy-absorbing floor-assembly according to claim 2, wherein a spring, serving as an intermediate deformable element, interposed between the piston (1.2) and the front of the front-end portion (1.1) of the deformable element, is provided with sites of predetermined fracture.

21. An energy-absorbing floor-assembly according to claim 12, wherein the crumpling zones are defined by stiffness, varying in longitudinal direction.

10 22. An energy-absorbing floor-assembly according to claim 12, wherein the crumpling zones are defined by unequal distances to each other.

23. An energy-absorbing floor-assembly according to claim 12, wherein the crumpling zones are defined by transition sites, serving as sites of predetermined fracture.

15 24. An energy-absorbing floor-assembly according to claim 12, wherein the crumpling zones are defined by honeycomb-shapes, having different stiffness.

20 25. An energy-absorbing floor-assembly according to claim 12, wherein the engaging parts and mating receptacles of interengaging assemblies define the crumpling zones of the first and second deformable element, where the mating receptacles are inserted into the respective engaging parts to connect both elements and to increase the energy-absorbing masses in any collision.

26. An energy-absorbing floor-assembly according to claim 25, wherein the interengaging assemblies comprise

25 upper and lower engaging pins (1.15), distributed on the respective upper and lower transition areas of juxtaposed crumpling zones of the first deformable element (1e) in x-direction; and

the mating L-shaped oblong holes, distributed along both legs of the U-shaped portion of the second deformable element (2b), serving as upper and lower transition sites of juxtaposed crumpling zones thereof;

30 where the corresponding crumpling zones of both deformable elements are interconnected when the mating L-shaped oblong holes are inserted into the upper and lower engaging pins in the y-direction, which are secured in the U-forms of the mating L-shaped oblong holes by the movement of the second deformable element in the x-direction.

27. An energy-absorbing floor-assembly according to claim 25, wherein the interengaging assemblies comprise

35 upper and lower engaging pins (1.15), distributed on the respective upper and lower transition areas of juxtaposed crumpling zones of the first deformable element (1e) in x-direction; and

40 the mating T-shaped oblong holes, distributed along both legs of the U-shaped portion of the second deformable element (2c), serving as upper and lower transition sites of juxtaposed crumpling zones thereto;

where the corresponding crumpling zones of both deformable elements are interconnected when the mating T-shaped oblong holes are inserted into the upper and lower engaging pins in the y-direction, which are secured in the U-forms of the mating T-shaped oblong holes by the movement of the second deformable element in the x-direction.

28. An energy-absorbing floor-assembly according to claim 25, wherein the interengaging assemblies comprise

engaging pins (1.15), distributed on the upper transition areas of juxtaposed crumpling zones of the first deformable element (1e) in x-direction; and

5 the mating T-shaped oblong holes, distributed along the upper leg of the U-shaped portion of the second deformable element (2d), serving as transition sites of juxtaposed crumpling zones thereof;

where the corresponding crumpling zones of both deformable elements are interconnected, when the mating T-shaped oblong holes are inserted into the engaging pins in the y-direction, which are secured in the U-forms of the mating T-shaped oblong holes by the
10 movement of the second deformable element in the x-direction, and when the sites of the lower transition areas of juxtaposed crumpling zones of the second deformable element are rigidly connected to the mating sites of the first deformable element.

29. An energy-absorbing floor-assembly according to claim 25, wherein the interengaging
15 assemblies comprise

engaging pins (2.1b), both ends of which are attached to both legs of the U-shaped portion of the second deformable element (2e), serving as transition sites of juxtaposed crumpling zones of the second deformable element (2e); and

20 the mating recesses of the first deformable element (1f) on the transition areas between the juxtaposed crumpling zones, which are provided with guide tubes (1.8b) in the common axis;

where the corresponding crumpling zones of both deformable elements are interconnected, when the engaging pins are inserted into the mating recesses and secured therein by an auxiliary tube (60c), projected through the guide tubes of all the crumpling zones in the
25 common axis.

30. An energy-absorbing floor-assembly of a motor vehicle, having a vehicle floor, vehicle body, front (35) and rear bumper (36) and a vehicle frame, defined by a pair of open cross sectional longitudinal runners (30a), a pair of open cross sectional side rails (34a), an open cross sectional tunnel rail (60d), a front (31a), rear cross member (33a) and an open cross
30 sectional intermediate cross member (32c), where all cross members are in connection with the vehicle floor, the pair of longitudinal runners, the pair of side rails and the tunnel rail and bores in the common axes are arranged in the front and rear cross member, comprising

a single deformable element (1), inserted between the front and rear cross member, through the side rails, the longitudinal runners, the tunnel rail and the intermediate cross
35 member, being in abutting relationship to both vehicle sides and fastened at the rear-end portion to the rear cross member;

a pair of independently operating piston devices, each of which, longitudinally arranged in the front section of the vehicle body, consists of an impact pan (5.1), located in the vicinity of the front bumper, a piston rod (5) and a front piston (1.2), located at a
40 distance of (10) to the front-end portion of the deformable element;

two pairs of auxiliary tubes (60c), projected through the deformable element and the bores of the front and rear cross member in the common axes, fastened to the front and rear cross member, securing and guiding the deformable element to prevent lateral buckling, when the deformable element absorbs the impact energy in any front collision;

45 a pair of bearing boxes (30.7), arranged in the front portions of the longitudinal runners, to guide the respective piston rods (5);

a pair of springs (4d), loosely guided by the piston rods, where the springs, biasing the front bumper via the impact pans, store minor energy up to the deflection of (10), when the vehicle collides against a barrier when parking, and release the energy, when the vehicle is reversed, thus pushing the bumper back to the home position and making repair unnecessary; and

a rear deformable element (3c), fastened to the attachment sites of predetermined fracture of both rear portions of the longitudinal runners;

thus ensuring the energy absorption in any front, side or rear collision or in a pile up.

31. An energy-absorbing floor-assembly of a motor vehicle, having a vehicle floor, vehicle body, front (35) and rear bumper (36) and a vehicle frame, defined by a pair of open cross sectional longitudinal runners (30a), a pair of open cross sectional side rails (34a), a pair of U-shaped tunnel rails (60e), a front (31b), rear cross member (33b) and an intermediate cross member (32b), where all cross members are in connection with the vehicle floor, the tunnel rail, the pair of longitudinal runners and the pair of side rails and bores in the common axes are arranged in the front and rear cross member, comprising

a pair of front deformable elements (1), each of which is inserted between the front and intermediate cross member, through the side rail, the longitudinal runner into the U-shaped tunnel rail and fastened at the rear-end portion to an auxiliary plate (32.6) of the intermediate cross member;

a pair of independently operating twin piston devices, each of which, longitudinally arranged in the front section of the vehicle body, consists of two piston rods (5, 5a), connected to the front bumper with sites of predetermined fracture, and a common front piston (1.2), fastened to the front-end portion of the front deformable element to prevent lateral buckling;

a pair of auxiliary front tubes (60c1), each of which is projected through each front deformable element, common front piston and the bore of the front and intermediate cross member in the common axis, fastened to the front and intermediate cross member and guides the front deformable element to prevent lateral buckling, when the front deformable element absorbs the impact energy in any front collision;

a pair of front double bearing boxes (30.7), the engaging receptacles of which are plug-in and force-locking connected to the mating parts of the respective front-end portions of the longitudinal runners, to guide the respective piston rods (5, 5a);

a pair of rear deformable elements (1), each of which is inserted between the intermediate and rear cross member, through the side rail, the longitudinal runner into the U-shaped tunnel rail and fastened at the front-end portion to an auxiliary plate (32.6) of intermediate cross member;

a pair of independently operating piston devices, each of which, longitudinally arranged in the rear section of the vehicle body, consists of a piston rod (5b), connected to the rear bumper with sites of predetermined fracture, and a rear piston (1.2), fastened to the rear-end portion of the rear deformable element to prevent lateral buckling;

a pair of auxiliary rear tubes (60c2), each of which is projected through each rear deformable element, the rear piston and the bore of the rear and intermediate cross member in the common axis, fastened to the rear and intermediate cross member and guides the rear deformable element to prevent lateral buckling, when the rear deformable element absorbs the impact energy in any rear collision; and

a pair of side deformable elements (2a3), each of which is inserted through the side rail, between the front and intermediate cross member, between the intermediate and rear cross member, connected to the front and rear deformable element and fastened to the

attachment sites of predetermined fracture of the respective auxiliary plates (31.5, 32.5, 33.5) of all cross members;
thus ensuring the energy absorption in any front, side or rear collision or in a pile up.

5 **32.** An energy-absorbing floor-assembly according to claim 31, wherein any part of a power train is housed in the tunnel space, defined by the pair of U-shaped tunnel rails and the vehicle floor.

10 **33.** An energy-absorbing floor-assembly of a motor vehicle, having a vehicle floor, vehicle body, front (35) and rear bumper (36) and a vehicle frame, defined by a pair of open cross sectional longitudinal runners (30a), a pair of open cross sectional side rails (34), a open cross sectional tunnel rail (60d), a front (31a), rear cross member (33a) and an intermediate cross member (32c), where bores in the common axes are arranged in all cross members in connection with the vehicle floor, the tunnel rail, the pair of longitudinal runners and the pair of side rails, comprising

15 a single deformable element (1), inserted between the front and rear cross member, through the side rails, the longitudinal runners, the tunnel rail and the intermediate cross member, being in abutting relationship to both vehicle sides and fastened to the intermediate cross member;

20 a pair of independently operating twin piston devices, each of which, longitudinally arranged in the front section of the vehicle body, consists of two piston rods (5, 5c), connected to the front bumper with sites of predetermined fracture, and a common front piston (1.2), fastened to the front-end portion of the deformable element to prevent lateral buckling;

25 a pair of front bearing boxes (30.7), the engaging receptacles of which are plug-in and force-locking connected to the mating parts of the respective front portions of the longitudinal runners, to guide the respective piston rods (5, 5c);

30 a pair of independently operating twin piston devices, each of which, longitudinally arranged in the rear section of the vehicle body, consists of two piston rods (5b, 5d), connected to the rear bumper with sites of predetermined fracture, and a common rear piston (1.2), located at a distance of (10) to the rear portion of the deformable element;

35 a pair of rear bearing boxes (30.7), the engaging receptacles of which are plug-in and force-locking connected to the mating parts of the respective rear portions of the longitudinal runners, to guide the respective piston rods (5b, 5d);

40 a pair of springs (4c), arranged between the rear-end portion of the deformable element and the respective piston rods (5b), where the springs, biasing the rear bumper, store minor energy up to the deflection of (10), when the vehicle collides against a barrier when parking, and release the energy, when the vehicle is reversed, thus pushing the bumper back to the home position and making repair unnecessary; and

 a pair of auxiliary tubes (60b), which are projected through the deformable element, both common front pistons, both common rear pistons and the bores of the front and rear cross member in the common axes, fastened to the front, intermediate and rear cross member and which guide the deformable element to prevent lateral buckling, when the deformable element absorbs the impact energy in any collision;

thus ensuring the energy absorption in any front, side or rear collision or in a pile up.

34. An energy-absorbing floor-assembly according to claim 33, wherein the bearing box is an extrusion component.

35. An energy-absorbing floor-assembly according to claim 34, wherein the bearing box has a number of bores to guide the piston rods.

5 36. An energy-absorbing floor-assembly according to claim 34, wherein the bearing box has a number of bores to guide at least one piston rod and to receive at least one auxiliary tube.

37. An energy-absorbing floor-assembly according to claim 33, wherein the bumper is substituted by at least one pair of impact pans.

10 38. An energy-absorbing floor-assembly, characterised by use of metal, compound material, glass fibre reinforced material or non-metal material for material of parts of the interengaging assembly, of the piston device, of the deformable element and of the deformable member.